

What is claimed is:

1. A plating apparatus, comprising:

- 5 a substrate holder capable of opening and closing for holding
a substrate such that the front surface of the substrate is exposed
while the back side and the edge thereof are hermetically sealed;
a plating tank for holding a plating liquid in which an anode
is immersed;
a diaphragm provided in said plating tank and disposed
10 between said anode and the substrate held by said substrate holder;
plating liquid circulating systems for circulating the
plating liquid through the respective regions of said plating tank
partitioned by said diaphragm; and
a deaerating unit provided in at least one of said plating
15 liquid circulating systems.

2. The plating apparatus according to claim 1, further
comprising a monitoring unit disposed downstream of said
deaerating unit for monitoring the concentration of dissolved
20 oxygen in the plating liquid.

3. The plating apparatus according to claim 1, wherein said
deaerating unit comprises at least a deaerating membrane and a
vacuum pump, the pressure on the decompressed side of said
25 deaerating unit being controlled.

4. The plating apparatus according to claim 3, further
comprising a monitoring unit disposed downstream of said

deaerating unit for monitoring the concentration of dissolved oxygen in the plating liquid.

5. A plating method, comprising;

5 providing a diaphragm between a substrate and an anode immersed in a plating liquid held in a plating tank;

circulating the plating liquid in each region of said plating tank partitioned by said diaphragm; and

10 plating the substrate while maintaining the concentration of dissolved oxygen in the plating liquid between 1 μ g/l (1 ppb) and 4 mg/l (4 ppm) by a deaerating unit.

6. A plating apparatus, comprising:

15 a cassette table for loading a cassette housing a substrate therein;

a substrate holder capable of opening and closing for holding the substrate such that the front surface of the substrate is exposed while the back side and the edge thereof are hermetically sealed;

20 a substrate loading/unloading unit for supporting said substrate holder, and loading and unloading the substrate;

a substrate transferring device for transferring the substrate between said cassette table and said substrate loading/unloading unit;

25 a plating tank for accommodating said substrate holder and the substrate held vertically and facing to an anode, and plating the surface of the substrate by injecting a plating liquid from the bottom thereof; and

a substrate holder transferring device having a transporter that grips the substrate holder and is vertically moveable, and transfers said substrate holder between said substrate loading/unloading unit and said plating tank.

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7. The plating apparatus according to claim 6, wherein said plating tank comprises a plurality of plating units accommodated in an overflow tank that accommodates dummy electrodes for dummy plating, each unit being adapted for accommodating and plating one substrate.

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8. The plating apparatus according to claim 7, wherein each plating unit is provided with a paddle that is disposed between said anode and the substrate, and reciprocates to agitate the plating liquid.

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9. The plating apparatus according to claim 8, wherein a paddle drive device for driving said paddle is provided on the opposite side of said substrate holder transferring device with respect to said the plating tank.

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10. The plating apparatus according to claim 6, comprising plating tanks for performing different types of plating, wherein each plating tank comprises an overflow tank and plating units for performing each type of plating, said plating units being accommodated in said overflow tank.

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11. The plating apparatus according to claim 10, wherein each

plating unit is provided with a paddle that is disposed between said anode and the substrate, and reciprocates to agitate the plating liquid.

5 12. The plating apparatus according to claim 11, wherein a paddle drive device for driving said paddle is provided on the opposite side of said substrate holder transferring device with respect to said the plating tank.

10 13. The plating apparatus according to claim 6, wherein a local exhaust duct is provided along one side of said plating tank.

15 14. The plating apparatus according to claim 6, wherein a stocker for storing said substrate holder in a vertical position is provided between said substrate loading/unloading unit and said plating tank; and said substrate holder transferring device has first and second transporters.

20 15. The plating apparatus according to claim 14, wherein said substrate loading/unloading unit is provided with a sensor for checking the contact state between the substrate and contact points when the substrate is loaded into said substrate holder; and said second transporter selectively transfers only such substrate that has a good contact with the contact points to a subsequent process.

25 16. The plating apparatus according to claim 14, wherein said substrate holder transferring device employs a linear motor as a means for moving said transporters.

17. The plating apparatus according to claim 14, further comprising a pre-wetting tank, a blowing tank, and a cleaning tank between said stocker and said plating tank.

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18. The plating apparatus according to claim 17, wherein said substrate loading/unloading unit is provided with a sensor for checking the contact state between the substrate and contact points when the substrate is loaded into said substrate holder; and said second transporter selectively transfers only such substrate that has a good contact with the contact points to a subsequent process.

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19. The plating apparatus according to claim 17, wherein said substrate holder transferring device employs a linear motor as a means for moving said transporters.

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20. The plating apparatus according to claim 6, wherein said substrate loading/unloading unit is constructed to support two substrate holders side by side that are slidable laterally.

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21. A plating apparatus for forming a protruding electrode on a substrate having wiring formed thereon, comprising:

a cassette table for loading a cassette housing the substrate therein;

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a plating tank for plating the substrate;

a cleaning unit for cleaning the plated substrate;

a drying unit for drying the cleaned substrate;

a deaerating unit for deaerating a plating liquid in the

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plating tank;

a plating liquid regulating unit for analyzing the components of the plating liquid and adding components to the plating liquid based on the results of the analysis; and

5 a substrate transferring device for transferring the substrate.

22. The plating apparatus according to claim 21, wherein at least part of said substrate transferring device transfers the
10 substrate by means of a linear motor.

23. The plating apparatus according to claim 21, wherein said plating liquid regulating unit adds components to the plating liquid by both a feedforward control method and a feedback control
15 method.

24. The plating apparatus according to claim 21, wherein said plating tank is adapted to plat the substrate such that the substrate is oriented vertically or slightly inclined.
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25. The plating apparatus according to claim 24, wherein the plating liquid is allowed to flow in said plating tank in a direction substantially parallel to the surface of the substrate held in said plating tank.

25 26. The plating apparatus according to claim 21, wherein the substrate is applied to plating, cleaning and drying processes while being held by said substrate holder.

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27. The plating apparatus according to claim 26, further comprising a drying unit for drying the plated substrate taken out of said substrate holder.

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28. The plating apparatus according to claim 21, wherein said cleaning unit and said drying unit are integrally constructed.

29. The plating apparatus according to claim 21, wherein said
10 plating tank comprises a plurality of plating units accommodated in an overflow tank, each unit being adapted for accommodating and plating one substrate.

30. The plating apparatus according to claim 21, wherein a
15 conductor for energizing the substrate to make it a cathode and a metal contact are made of stainless steel, or at least those surfaces of said conductor and said metal contact which contact with each other or another member are coated with gold or platinum.

20 31. The plating apparatus according to claim 21, wherein a regulation plate is disposed between the substrate, serving as a cathode, and an anode facing to the substrate, in said plating tank.

32. The plating apparatus according to claim 21, further
25 comprising a sensor for checking the contact state between the substrate and electrical contact points for energizing the substrate to make it a cathode.

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33. The plating apparatus according to claim 21, wherein said plating liquid regulating unit is provided in a housing that accommodates said cassette table, said plating tank, said cleaning unit, said drying unit, said deaerating unit, and said substrate transferring device.

34. The plating apparatus according to claim 21, wherein said plating liquid regulating unit is provided outside a housing that accommodates said cassette table, said plating tank, said cleaning unit, said drying unit, said deaerating unit, and said substrate transferring device.

35. A plating apparatus for forming a protruding electrode on a substrate having wiring formed thereon, comprising:

- a cassette table for loading a cassette housing the substrate therein;
- a pre-wetting tank for applying a pre-wetting treatment to the substrate to increase the wettability thereof;
- a plating tank for plating the substrate after the pre-wetting treatment;
- a cleaning unit for cleaning the plated substrate;
- a drying unit for drying the cleaned substrate;
- a deaerating unit for deaerating a plating liquid in the plating tank; and
- a substrate transferring device for transferring the substrate.

36. The plating apparatus according to claim 35, wherein at

least part of said substrate transferring device transfers the substrate by means of a linear motor.

37. The plating apparatus according to claim 35, wherein said
5 plating tank is adapted to plat the substrate such that the substrate is oriented vertically or slightly inclined.

38. The plating apparatus according to claim 37, wherein the
10 plating liquid is allowed to flow in said plating tank in a direction substantially parallel to the surface of the substrate held in said plating tank.

39. The plating apparatus according to claim 35, wherein the
15 substrate is applied to pre-wetting, plating, cleaning and drying processes while being held by the substrate holder.

40. The plating apparatus according to claim 39, further
comprising a drying unit for drying the plated substrate taken out
of said substrate holder.

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41. The plating apparatus according to claim 35, wherein said
cleaning unit and said drying unit are integrally constructed.

42. The plating apparatus according to claim 35, wherein said
25 plating tank comprises a plurality of plating units accommodated in an overflow tank, each unit being adapted for accommodating and plating one substrate.

43. The plating apparatus according to claim 35, wherein a conductor for energizing the substrate to make it a cathode and a metal contact are made of stainless steel, or at least those surfaces of said conductor and said metal contact which contact
5 with each other or another member are coated with gold or platinum.

44. The plating apparatus according to claim 35, wherein a regulation plate is disposed between the substrate, serving as a cathode, and an anode facing to the substrate, in said plating tank.

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45. The plating apparatus according to claim 35, further comprising a sensor for checking the contact state between the substrate and electrical contact points for energizing the substrate to make it a cathode.

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46. An apparatus for forming a protruding electrode on a substrate having wiring formed thereon, comprising:

a cassette table for loading a cassette housing the substrate therein;

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a pre-soaking tank for applying a pre-soaking treatment to the substrate;

a plating tank for plating the substrate after the pre-soaking treatment;

a cleaning unit for cleaning the plated substrate;

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a drying unit for drying the cleaned substrates;

a deaerating unit for deaerating the plating liquid in the plating tank; and

a substrate transferring device for transferring the

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substrates.

47. The plating apparatus according to claim 46, wherein at least part of said substrate transferring device transfers the substrate by means of a linear motor.

48. The plating apparatus according to claim 46, wherein said plating tank is adapted to plat the substrate such that the substrate is oriented vertically or slightly inclined.

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49. The plating apparatus according to claim 46, wherein the plating liquid is allowed to flow in said plating tank in a direction substantially parallel to the surface of the substrate while being held in said plating tank.

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50. The plating apparatus according to claim 46, wherein the substrate is applied to pre-soaking, plating, cleaning and drying processes while being held by the substrate holder.

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51. The plating apparatus according to claim 46, further comprising a drying unit for drying the plated substrate taken out of said substrate holder.

52. The plating apparatus according to claim 46, wherein said cleaning unit and said drying unit are integrally constructed.

53. The plating apparatus according to claim 46, wherein said plating tank comprises a plurality of plating units accommodated

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in an overflow tank, each unit being adapted for accommodating and plating one substrate.

54. The plating apparatus according to claim 46, wherein a
5 conductor for energizing the substrate to make it a cathode and a metal contact are made of stainless steel, or at least those surfaces of said conductor and said metal contact which contact with each other or another member are coated with gold or platinum.

10 55. The plating apparatus according to claim 46, wherein a regulation plate is disposed between the substrate, serving as a cathode, and an anode facing to the substrate, in said plating tank.

15 56. The plating apparatus according to claim 46, further comprising a sensor for checking the contact state between the substrate and electrical contact points for energizing the substrate to make it a cathode.

20 57. An apparatus for forming a protruding electrode on a substrate by plating the substrate with at least two kinds of metals, comprising:

a plurality of plating tanks each for plating the substrate with each of the above metals; and

25 a substrate transferring device for transferring the substrate, wherein said plating tanks are disposed along a transferring path of said substrate transferring device.

58. The plating apparatus according to claim 57, wherein at

least part of said substrate transferring device transfers the substrate by means of a linear motor.

59. The plating apparatus according to claim 57, wherein said
5 plating tank is adapted to perform plat the substrate such that the substrate is oriented vertically or slightly inclined.

60. The plating apparatus according to claim 59, wherein the
10 plating liquid is allowed to flow in said plating tank in a direction substantially parallel to the surface of the substrate held in said plating tank.

61. The plating apparatus according to claim 57, wherein the
15 substrate is plated with two or more kinds of metals while being held by a substrate holder.

62. The plating apparatus according to claim 61, further
comprising a drying unit for drying the plated substrate taken out
of said substrate holder.

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63. The plating apparatus according to claim 57, wherein said
plating tank comprises a plurality of plating units accommodated
in an overflow tank, each unit being adapted for accommodating and
plating one substrate.

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64. The plating apparatus according to claim 57, wherein a
conductor for energizing the substrate to make it a cathode and
a metal contact are made of stainless steel, or at least those

surfaces of said conductor and said metal contact which contact with each other or another member are coated with gold or platinum.

65. The plating apparatus according to claim 57, wherein a
5 regulation plate is disposed between the substrate, serving as a cathode, and an anode facing to the substrate, in said plating tank.

66. The plating apparatus according to claim 57, further
10 comprising a sensor for checking the contact state between the substrate and electrical contact points for energizing the substrate to make it a cathode.

67. An apparatus for forming a protruding electrode on a
substrate having wiring formed thereon, comprising:
15 a cassette table for loading a substrate cassette thereon;
a plating tank for plating the substrate;
a cleaning unit for cleaning the plated substrate;
a drying unit for drying the cleaned substrate;
a deaerating unit for deaerating a plating liquid in the
20 plating tank;
an annealing unit for annealing the plated substrate; and
a substrate transferring device for transferring the
substrate.

68. The plating apparatus according to claim 67, further
25 comprising a resist peeling unit for peeling a resist used as a mask off from the surface of the substrate.

69. The plating apparatus according to claim 68, further comprising a seed layer removing unit for removing an unnecessary seed layer from the surface of the substrate after the plating process.

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70. A method for forming a protruding electrode on a substrate having wiring formed thereon, comprising:

holding a substrate taken out of a cassette by a substrate holder;

10 pre-wetting the substrate held by said substrate holder;

plating the pre-wetted surface of the substrate by immersing the substrate together with said substrate holder in a plating liquid;

15 cleaning and drying the plated substrate together with said substrate holder; and

taking the substrate out of said substrate holder and drying the substrate.

20 71. A method for forming a protruding electrode on a substrate having wiring formed thereon, comprising:

holding a substrate taken out of a cassette by a substrate holder;

pre-soaking the substrate held by said substrate holder;

25 plating the pre-soaked surface of the substrate by immersing the substrate together with said substrate holder in a plating liquid;

cleaning and drying the substrate together with said substrate holder; and

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taking the substrate out of said substrate holder and
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